

The handicaps under which Dr. Turner's work was accomplished were many, and were modestly and bravely met. Only one of these was the limitations of a small salary, out of which he was compelled to purchase his own tools and library for research, since he did not enjoy the access to laboratories and institutions where equipment is supplied.

And when at last one considers the quantity and quality of his scientific research work, accomplished under handicaps, and in addition to a full life of other activities and unusual efficiency in the classroom, one can only say—well done!

PHIL RAU.

The Lower Permian Insects of Kansas. Preliminary Announcement.

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The Yale University Expedition to the Lower Permian insect beds in Kansas, originally suggested by me to Professor Charles Schuchert, organized by him, and carried out by Dr. Carl O. Dunbar in the summer of 1921, brought back about 2000 specimens of fossil insects, many of them in a remarkably fine state of preservation. This locality was discovered by Dr. E. H. Sellards in 1902 and his publications relating to them are given below.* The Yale Collection has recently been received by me in Nelson for description, and the preliminary study and sorting of the immense mass of material is now completed. Owing to the remarkable interest of these fine fossils, a short summary of results is here given, with Professor Schuchert's permission, in order that entomologists may have some general idea of the composition of the insect fauna of that period, and some indication of certain problems in evolu-

* E. H. Sellards, *Discovery of Fossil Insects in the Permian of Kansas*. Amer. Jour. Sci., vol. 16, 1903, pp. 323-324. *Types of Permian Insects*. Ibidem, pt. I, vol. 22, 1906, pp. 249-258; pt. II, vol. 23, 1907, pp. 345-355; pt. III, vol. 27, 1909, pp. 151-173.

tion which the new material goes a long way toward solving. The actual series of papers in which the fossils are being described will appear from time to time in the *American Journal of Science*, published at New Haven, Connecticut.

The beds are probably unique in the very large number of individuals of certain species which occur there. The 2000 odd specimens appear to represent well under 100 actual forms. By far the most abundant order in actual specimens, and probably also in species, is the Order Protorthoptera; but these are nearly all greatly reduced types, and a closer study may indicate clear lines of ordinal division amongst them. Of undoubted Protorthopterous origin are certain types which closely resemble the recent Perlaria, Embioptera, Raphidiodea and Sialoidea. There are also some very small wings which appear to have rather close affinity with the Sternorrhynchous Homoptera, and at the same time do not stand far from some of the reduced types of Protorthoptera.

Several fine impressions occur of what appeared at first sight to be undoubtedly a true Beetle, with the body, elytra and hindwings complete. A careful study of this form reveals the presence of short cerci, while the elytra have a very clear venation of Orthopteroid type. In order to elucidate the problem further, I made an enlarged drawing, and then creased it along the concave veins; the model so made shuts up like an earwig's wing, but without the transverse infolding of the apical portion. There can be little doubt, then, that this beetle-like form is really one of the ancestors of our modern Dermaptera, and requires a new Order for its reception. This Order I propose to call *Protodermaptera*.

Cockroaches are, of course, present, but not at all numerous.

The only true Holometabola, which can be recognized undoubtedly as such, are a number of very small wings, averaging 5 mm. long, belonging to the Order Mecoptera, and almost exactly similar, apart from their much smaller size, to the existing Australian Choristidae and the extinct Permochoristidae.

Of very great interest are the Palaeodictyoptera, of which one fine species is present, exceedingly closely allied to certain forms found in the Upper Carboniferous of Europe. Of one

of these a description and photographs have been prepared for insertion in Dr. Dunbar's introductory study of the fossil beds soon to appear in the *American Journal of Science*. It is one of the most perfect fossil insects ever discovered; practically the whole body is preserved, with the long cerci showing clearly their close annulation and rings of hairs; the wings spread out horizontally as in the case of a modern Anisopterous Dragonfly; the beautiful color-pattern perfect; and the macrotrichia on some of the veins quite clearly visible.

The Mayflies (Plectoptera) are abundant, and are all characterized by the presence of four almost equal wings, whose venation is almost exactly on the same plan as that of the forewing of the Order today, except that there is no definite tornus (this latter evidently developing in correlation with the reduction of the hindwing).

Of very great interest are the fine Protodonata, of which there are three very distinct species, inclusive of *Typus permianus* already discovered and described by Dr. Sellards. This genus, and an allied but larger form expanding about 15 inches, are undoubtedly true Meganeuridae; the other is a much smaller form allied to *Protagrion*. The largest specimen is almost perfect, and allows of the complete working out of the homologies of the wing-veins of this Order, which shows some close resemblances both to the Plectoptera and to recent Odonata.

Perhaps the most wonderful find of all, as regards its value in elucidating venational and phylogenetic problems, is the wing of an undoubted Zygopterous dragonfly of very remarkable structure. It is very slender, with long petiole, complete nodus and pterostigma, incomplete arcus, and with very few cross-veins placed very wide apart; *e. g.*, although the wing is very long, there are only four postnodals. This wing solves at once the whole problem of Dragonfly wing-venation, and shows what a will-of-the-wisp we have all been following over the supposed trachea Rs of Needham. The whole vein called M by all Odonatologists, inclusive of all its branches and Needham's Rs, is clearly seen to be the true radial sector, which is many-branched as in Plectoptera. The

missing vein M is present in the basilar space, but fuses with Cu half-way to arculus, and the two fused veins again part company under the open discoidal cell. This accounts for the anomaly of the supposed Cu of recent Odonata dividing into an upper *concave* (supposed) Cu_1 and a lower *convex* (supposed) Cu_2 . The upper concave vein is really M, and the lower convex vein is really Cu. In the Protodonata, M remains a simple unfused vein, at any rate in the Meganeuridae. In the new Zygopteron, there is, of course, no anal vein, but the cross-vein Ac is present, placed well before the level of the first antenodal. Coupled with the evidence which I have obtained from a study of the Liassic Odonata, it is now perfectly clear that the original type of the Odonata was Zygopterous, with narrow, petiolate wings, and that the gradual broadening of the anal area led, on the one hand, to various Calopterygid types, and on the other to the Anisozygoptera, from which the true Anisoptera arose in the Jurassic. To Dr. C. H. Kennedy, of the Ohio State University, Columbus, Ohio, must be given credit of having first recognized, from his comparative studies of the penes of the males, the correct order of evolution of the various families of recent Odonata; and I wish here to express the satisfaction it gives me to be able to acknowledge the great merit of his work, and to close up, once and for all, the erroneous lines of thought which I, in company with almost every other student of Odonata, had been following for many years. In order that no avoidable delay shall take place in the publication of this most important discovery, I am arranging for the first part of my work on the Kansas fossils to include the Palaeodictyoptera, Protodonata and Odonata.

The Life History of *Phaedrotes piasus* Boisd. (Lepidoptera : Lycaenidae).

By KARL R. COOLIDGE, Hollywood, California.

Phaedrotes piasus Bdv., better known in literature as *sagittiger* Felder, is a butterfly of wide range in the West, and in their recent Check List Drs. Barnes and McDunnough give it two races, formerly classed as synonyms, these being *catalina*